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Anti-Nuclear Series - 1

The NARORA Nuclear Reactors

The Other India Press
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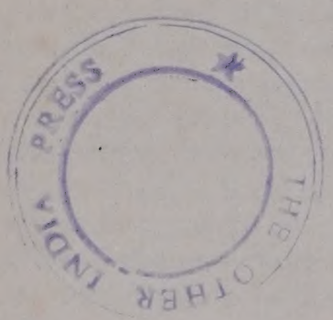
The NARORA Nuclear Reactors



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with support from Dr Dhirendra Sharma

The second part of this booklet has been taken from the 1989 Report of the Comptroller and Auditor General of India.

Preface

As India races to catch up with the technologically advanced nations, there is a dead weight tied to its ankles-its people. It is this load which is getting jettisoned as India approaches the "21st Century". Consider the blind adoption of capital intensive technology, regardless of its limited utility to our vastly different conditions, the large-scale plans for big dams, regardless of the dislocation of thousands of villagers from their source of livelihood, the dogged determination to go ahead with nuclear energy, regardless of the fact that its claims to cleanliness, cost-efficiency and safety are being increasingly questioned in the countries which first adopted it.

We are a group of social activists, teachers, students and professionals based in Delhi who view with rising concern and frustration the trajectory of a development strategy which leaves the people behind. The nuclear power plant at Narora embodies for us the worst aspects of such development - the waste of resources on a technology which has revealed its severe limitations and dangers as well as the tragic uprooting of thousands of villagers and their transformation into the anonymous mass of the urban unemployed.

Through a series of interviews with people from the villages dislocated around the Narora Atomic Power Plant, we try to suggest some of the dimensions of a vast human problem. The villagers have been resettled in colonies temporarily named Sundarnagar, Bijaun/Badipur Nayi Basti and Ambedkar Nagar, and some are in previously existing rural settlements like Ramghat and Kalkatti, all within a 6 kilometers radius of the plant. Some of those who spoke to us did not disclose their names out of fear of the authorities and maybe partly, because of distrust of strangers. In this booklet we also contest the claims of the Department of Atomic Energy (DAE) on technical grounds - our emotions and values are not our only armour against their 'hard facts'.

We believe that the only development possible for India would come about through addressing internal inequalities, not by attempts to "catch up" with the West. That is, development not in the sense of ***More***, but in the sense of ***More equal.*** Or else, we would be in the position of Brazil, whose President once said - 'The economy is doing fine. The people are not.'

Introduction to Narora Atomic Power Plant

Narora is a small town situated on the banks of the Ganga in the Bulandshahr district of U.P. In a straight line, it is about 120 kms from Delhi. It is prime agricultural land made fertile by the soil of the Ganga. Its people are predominantly agriculturists. Rice, Bajra, Jowar, Wheat, Corn and Vegetables are grown here. On 13 January 1974, Narora was selected as a site for an Atomic Power Plant. This was done in spite of the fact that it was fertile agricultural land, it was on the banks of the Ganga, in the middle of a thickly populated region and that it was in an active seismic zone with newly formed alluvial soil.

One of the most immediate and painful of repercussions has been the displacement of thousands of people belonging to the five villages (Gangabas, Hakimpur, Bijaon, Badipur, Teen Meel) which lay within the exclusion zone of the 1.6 km radius around the plant. The people who lived here were asked to leave their homes and lands - homes they had lived in and lands they had tilled for generations, as far back as they could remember. How they were evicted is a sordid tale of broken promises, misinformation and rank corruption that unfolds itself in the following pages. Further, the 22 villages which lie within a "control area" of 5 km radius would be completely under the surveillance and control of the DAE.

How the plant works - or doesn't

Narora Atomic Power Plant (NAPP) has 2 reactors with a capacity of 235 MWe each. NAPP-1 went critical on 12th March 1989 and was declared operational on 15th October 1989, although by this time due to safety lapses, the Atomic Energy Regulatory Board had ordered it to be shut down. Ironically, it was in this shut down condition that the Prime Minister declared the plant 'operational' and 'commissioned' it! It has still not resumed production as this goes into print (January 1990).

A nuclear reactor consists of a reactor vessel which contains a mass of fuel in the form of fuel rods. These are very expensive and have to be manufactured with extreme care from radio-active material. When a fission chain reaction occurs, these fuel rods generate heat. Pressurized water in the Primary Cooling System takes the heat away from the fuel rods. From here the heat is transferred to the secondary cooling system to produce steam which runs a turbine to generate electricity. The primary cooling system is completely sealed as the water in it is highly radio-active and dangerous.

Within the core, between the fuel rods, there are control rods which control the rate of the reactions. The reaction rate increases when the control rods are pulled out and decreases when they are pushed in.

There are Emergency Core Cooling Systems and many other safety devices including standby devices, and further standby devices to these. This indicates the enormous possibility of mishaps (the Department of Atomic Energy euphemistically calls them "incidents").

The dangers: possibility of accidents

These safety devices notwithstanding, the dangers are very real and can have very far reaching consequences. If the emergency core cooling system fails for any reason, the fuel rods get exposed. This can lead to their partial or total "melt down". This results in a non-recoverable reaction core, and radio-activity leaking into the containment (as at Three Mile Island in the U.S.A. in 1979, which has still not been de-commissioned fully today, 10 years after the accident). However, if the accident is not controlled in time it can result in a Chernobyl type explosion, venting large quantities of highly radio-active material directly into the atmosphere. The areas which are likely to be affected by atomic fallout include Delhi, Meerut, Gurgaon, Faridabad, Mathura, Bharatpur, Agra, Aligarh, Etah, Bareilly and Moradabad. The Ganga would carry the radio-active discharge thousands of miles along its course through UP, Bihar and West Bengal into the Bay of Bengal.

The dangers: Normal working of the plant

Even if there is no accident, the normal operation of any Atomic Power Station necessarily involves the escape of varying quantities of radio-active materials into the cooling water and radio-activity that gets past the primary containment chamber, gets sucked and thrown out of the chimney stacks. This enters the food chain (viz, water to grass/crops to cow to milk/food to humans) thus exposing people to radio-activity, and the risk of cancer.

Besides risk of radio-activity there is thermal pollution of the water body (in this case the Ganga). As per the DAE's own calculations, the heat wasted into the Ganga at NAPPS will be approximately equivalent to 1400 MW, thus affecting aquatic life down stream.

The operation of NAPS will produce radio-active waste which will be stored in concrete trenches within the boundary of NAPS. This will remain

dangerous for hundreds of years. And any cracks in the concrete (due to poor quality of material or a mild seismic tremor) will allow dangerous materials to seep into ground water and into the Ganga.

In order to keep NAPP and other Atomic Power Stations working, fuel has to be mined, processed and converted into fuel rods. After these fuel rods are used they have to be stored, reproduced and finally, highly radio-active waste is to be stored safely for tens of thousands of years.

The life of NAPP is about 25 years. After this, even though no power will be generated, the structure will remain radio-active and dangerous for thousands of years. Electricity will be required to keep the plant from harming the environment such as by the running of heavy duty refrigeration plants to keep the high level wastes cool. Are we prepared to risk the health of future generations for just 25 years of electricity?

'Several workers observed bubble formations at many points on the outer wall of the containment building.... They are mending the structure with araldite....'

Union Member, Parmanu Urja Shramik Sangh, NAPS

Hindustan Times Sunday Magazine, Dec. 27, 1987

I would like to ask, " Are we not spending too much money on health and safety? Should we not have a look and findout whether the international standards of safety (in nuclear programmes) are indeed that necessary? Should we follow the international standards blindly?" I think we should have the courage to look at these standards specially where they are leading to runaway costs.

Raja Ramanna
Chairman, DAE, 1983
(From India's Nuclear Estate, Dhirendra Sharma)

Relocation and Compensation

The dislocation has been enormous, farmers have lost their land, labourers their employment. The people of the dislocated villages looked on helplessly as bulldozers, specially brought in from Delhi, converted their settlements to rubble. Compensation, when it has reached the people at all, has been inadequate. It is, in any case, in the form of cash, which has been spent to build new houses or level the land where resettlement has been done.

The area to which many of them have been shifted, that is around Kalkatti, belongs to the Irrigation Department which is threatening to evict them as squatters.

Very few have been given employment in the plant which has destroyed their entire way of life.

Name : Yadiram, Village: Ramghat

"A month or two before Holi, we were forcibly evicted from the village, everything was thrown out. There we used to farm, but we have nothing to do here. The contractor of sand near the Ganga asks for a hundred rupees as bribe for a job; those who have money are working there, those who don't, are not... Around 120-125 people of our village are here at this site. Even before we could harvest our wheat, our belongings were all thrown out. They threatened to beat us... DM Sahib brought the police with him. My father, brothers were all separated, earlier we all used to live together.

In our village we had around 30-40 bighas of land... We were given altogether Rs. 70,000. We were promised around 2-3 lakhs. None of us got any jobs... Getting the compensation was quite difficult - these leaders, government employees, the Patwari - they kept all the money."

Name : Sevati, Village : Ramghat

"Compensation was given only for our huts. Nothing was given for our land... they say that money will be given for land too. Those who had land will get money, but those who didn't have any, what will they eat?"

Name: Rambharose, Village : Ramghat

"Money was given only for the land which was registered. But nothing was given for the rest of the land on which we have worked for generations.

We were given Rs. 20,000, they said that if we deposit Rs. 10,000 then we could get our money - advocates at Narora told us this..."

Name : Dhasuram, Village : Ramghat

"They told us to vacate the village in eight days. We said no, it will take us two months. We have to build houses. We told them we will stay here. Then 250-300 people came, asking us to get out. They threw out our utensils and other belongings although they did not beat us.... The people of Bijaun, Badipur are educated. They got their money. We belong to the Malhar caste, we are illiterate. Because we are stupid, we got less compensation, they just caught us by our ears and ordered us to leave.

...We have to work a lot more here but still our stomachs are empty".

Name : Unknown (Woman)
Colony : Bijaun Nayi Basti

"... DM Sahib came and said that they are giving land of the Irrigation Department to us, free. They promised to make roads, give electricity, dig wells and tanks too. But these were all promises. Once we vacated the village nothing was given...

We used to farm there, had a lot of land-around 300 bighas. Here they did not give us any land. We did get compensation, though. We also got this land to live in. It is free of cost but the ground is uneven and full of deep ditches.

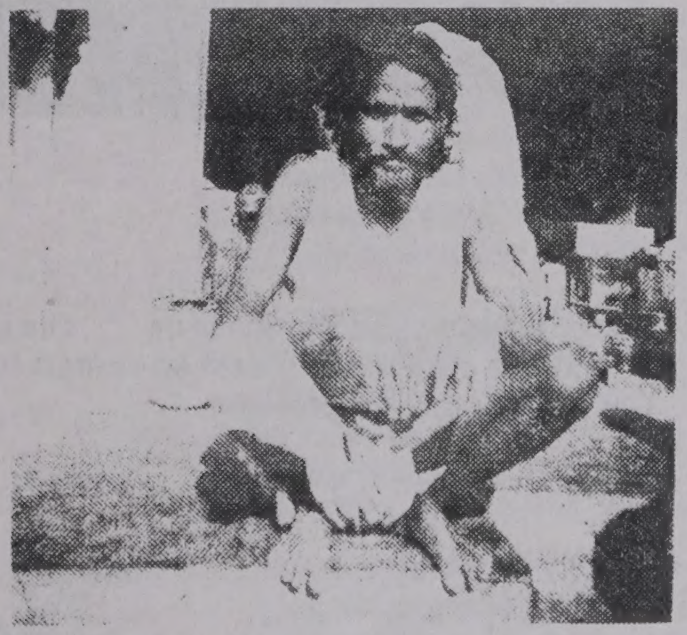
... Our only source of income was our farm, now we have nothing, no employment. We are thinking of starting something by the roadside...."

Name : Sukhdev
Colony : Bijaun Nayi Basti

"I work in the plant. But no one else was given work there. Only those who had employment earlier are still working there. A lot was promised - we will give this, we will give that, but nothing was given. For land worth Rs. 20,000 only 7,500 - 8,500 rupees were given...."

Name : Rameshwar
Colony : Bijaun Nayi Basti

"No one came forward to help us. The political leaders, the deputy collector - all of them are in league. We did not get just compensation for our lands. The land we have been given to live in has big ditches and potholes. During the monsoons it will be full of water....."



Name : Baburam
Colony : Bijaun Nayi Basti

".... All our lands were taken but a fair compensation was not given in return.... Now all the money we got has been spent on filling the ditches in and levelling the land.

We told one Officer that we have no land, no work, what will we do? We will have to sell our animals...."

Name : Kalawati
Colony : Bijaun Nayi Basti

"For 100 bighas of land I got only 5000 - 6000 rupees. Part of the money is still to be received. ....Not only this, but someone took Rs. 300 from us saying that it will increase in the future. But we got nothing back, not even our 300 rupees."

(We gather from this that the sudden exposure to cash for people who don't know how to handle it, is full of dangers of another sort. Evidently, some swindlers have exploited the ignorance of these people.)

Name : Unknown (Man)
Colony: Ambedkar Nagar

"This plant has not benefited us in any way, no employment was given to us. Only 20-25 people belonging to high castes have got work there...."

Name : Udai Singh
Colony : Ambedkar Nagar

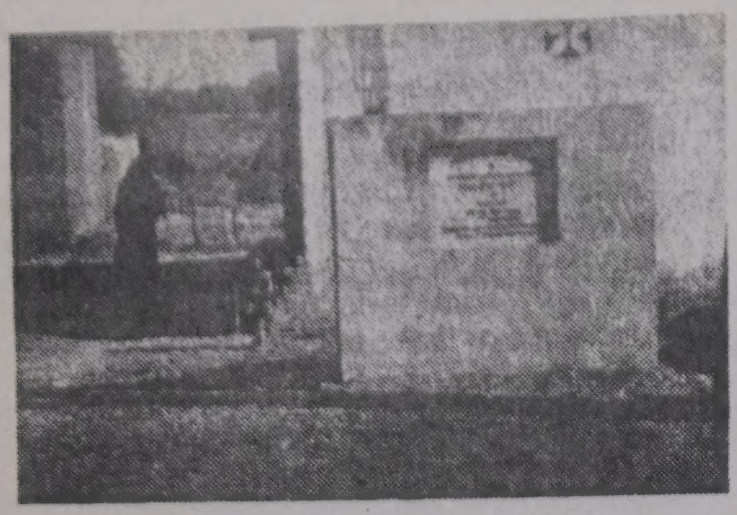
"... they had told us that at least one person from each family will be given work in the plant. But no, nothing was given...."

Name : Durga Prasad
Colony : Ambedkar Nagar

"We have been given 50 metres of land - there's barely enough to rest our charpais. The little money we got has been spent in building a house. We have difficulty in making ends meet..."

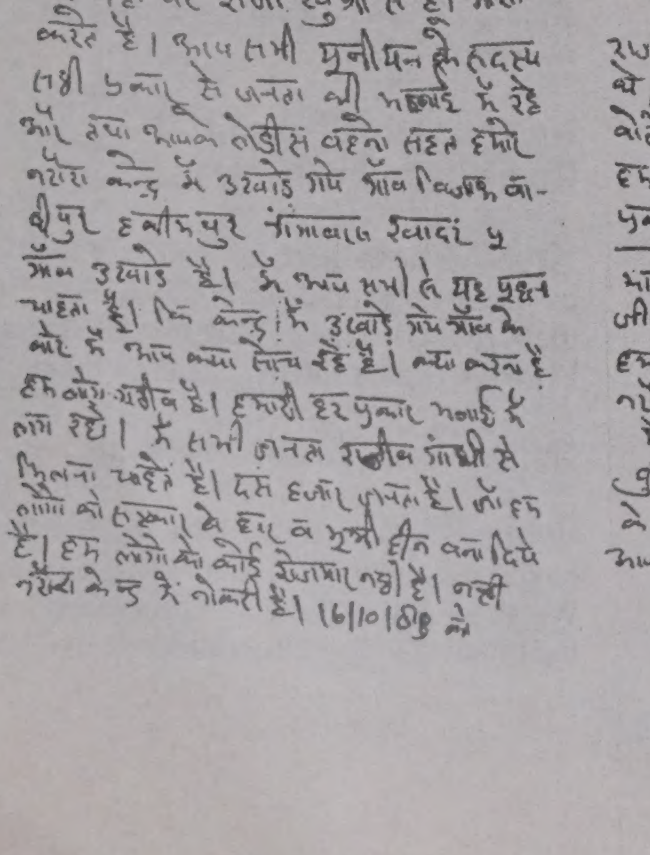
Name : Sita, Village : Kalkatti

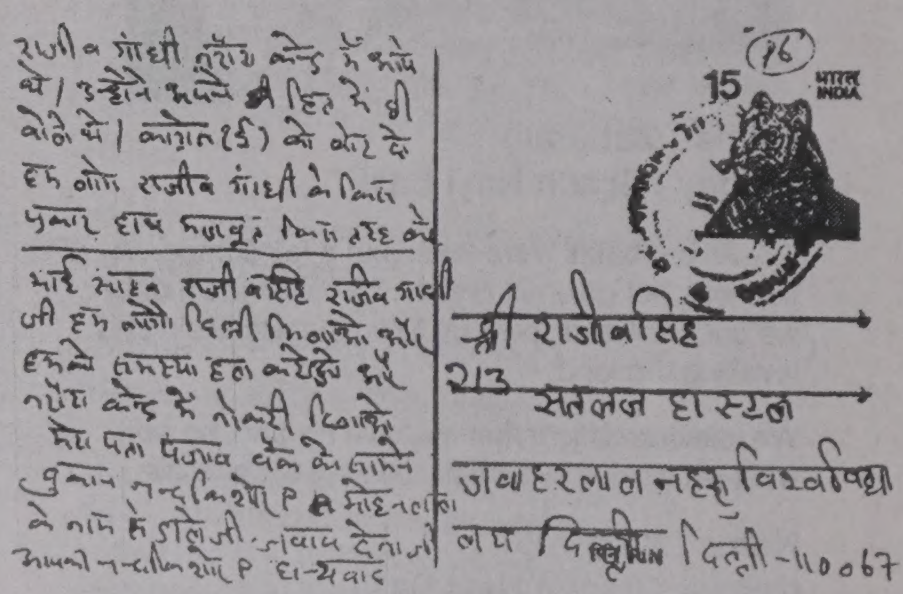
"We used to farm, earlier. Here my daughter-in-law has to work at the kiln with her 10-day old infant. We all go to work there. For a day's work from 7 in the morning to 6 in the evening we get 8 rupees".



One of the new settlements has been sanctified by a foundation stone laid by the District Magistrate of Bulandshahr (left). The impressive entrance to this settlement, however, is belied by the condition in which the dislocated villagers actually live (below) Please note also, that the houses in the photograph on the left have been built, not by the authorities who laid the foundation stone, but by the villagers themselves.

This postcard was sent to one of us - "... Our land and houses are gone..... please let us meet Rajiv Gandhi and solve our problem...."





A Layman's corrected Guide to Narora Atomic Power Station

Narora Atomic Power Station (NAPS) was inaugurated by the Prime Minister, Shri Rajiv Gandhi, on October 15, 1989. And the guns of the Department of Atomic Energy (DAE) boomed in the National dailies. The technical achievements of our scientists and engineers have been lauded, and the DAE has brought out an advertisement, "A layman's guide to NAPS" by their Director for Environment and Public Awareness, Shri G.V. Nadkarny, in the form of questions commonly asked, with reassuring answers by the DAE. What follows is a selection of the very same questions, with answers which bring out the untold story of NAPS.

Q. 2. How much electricity will it produce?

DAE. NAPS has two units each with a capacity of 235 MWe of which about seven per cent will be used to run the inhouse equipment (unit loads) and the rest will be fed into the grid. The net output from the station will be about 435 MWe.

The truth: The designed output of two 235 MWe units is 435 MWe. However, the performance of the other NPPs in India as given below present another aspect:

Rajasthan (RAPS) 2 x 220 MWe	= 440 MWe, Plant load factor <40%
Madras (MAPS) 2 x 235 MWe	= 470 MWe, plant load factor <40%.
Tarapur (TAPS) 2 x 210 MWe	= 420 MWe, Plant load factor 50%

These NPPs are all of foreign design and the snags which cause the poor plant load factor should have been all debugged. But NAPS is an indigenous design and the snags are yet to be encountered. An optimistic estimate of power from NAPS would be 40% of 435 MWe, or 175 MWe. Thus the cost per unit of power generated will shoot up, making the plant quite uneconomical.

Q. 3&4 Why do you designate unit out put as 235 MWe?
Where does the remaining 70% of the reactor heat go? Does the customer pay for this heat?

DAE: MWe stands for Mega Watts electrical (ten lakh watt), and gives the rating of the electrical generator. To produce this electrical power, the nuclear reactor must have a rating of 3.5 times as much i.e. about 835 MWth (Mega Watts thermal) since the effiency of conversion of heat energy into electrical energy is only about 28% to 30% as in coal thermal plants.

About seventy percent of the heat appears in the turbine condenser where the steam condenses. The condensed steam is reused while the heat is given away to the surrounding environment, i.e. to the lake, rive sea or atmosphere. At Narora it is given to the atmosphere through the huge cooling towers so that the cooling water intake requirements from the Ganga are greatly reduced and the river is saved from any pollution caused by dumping the heat. Yes, one pays for all the heat generated in the fuel whether it is uranium fuel or coal.

The truth: The thermal efficiency of 28-30% is a part of the thermodynamic steam cycle. The NPP generates heat from nuclear fission while thermal power plants burn fossil fuel to produce heat; both then produce steam to drive a trubine and generator. Thus, while thermal power plants create lots of smoke and no radioactivity, NPPs create no smoke & lets of radioactivity. And both cause identical thermal pollution of the environment. For every 100 MWe of generated power, 330 MWth (Megawatts thermal) is 'lost' as heat. But it is not lost at all; it is what constitutes thermal pollution. And while the customer may pay for this 'lost' component, every citizen (and very few are consumers of electricity) suffers the pollution.

Q. 5 What is the total installed capacity of electrical generation in U.P.? What is the demand? What are the various sources of generation of electricity?

DAE: A the total installed capacity in U.P. is 4900 MWe. The demand is 5700 MWe. Hence, there is a deficit of 800 MWe. The contribution by various sources is:

Coal Thermal	: 3500 MWe
Hydel	: 1400 MWe

The truth: The rise of total electric energy demand has always been faster than the increase in genera-

tion (supply). The national figures (in MWe) are below, and UP is representative

	Supply	Demand	Shortage
1984-85	24,971	30,200	5,229
1989-90	37,634	47,014	9,380
1994-95	61,418	72,711	11,293

Thus, rising demand constantly outstrips rising supply. The financial requirement is Rs. 80,000 crores to be spent by 1994-95, which can never be found. This would also mean building 40 power stations of 235 MWe every year for the next five years starting now! This is clearly impossible. Moreover, to what use is this constantly rising supply of electricity put? Who benefits from airconditioning and 5 star hotels and the production of luxury goods like washing machines and vacuum cleaners?

Q. 8 Is it true that Narora site was not cleared by the Site Selection Committee of DAE?

DAE: No, it is not. Narora is located in the Northern Electricity Region. The Site selection Committee of DAE under the Chairmanship of Shri M.N. Chakravarti submitted its report relating to the Northern Region in February, 1972 and as per the report, Narora is recommended as a number one site. One of the members of that Committee. Dr. A.K. Ganguly indicated a different order of priority of the sites compared to the other members stating the following reasons:

As designs were not available then for health and safety evaluation for locating plants at sites with alluvial sub-soil and moderately seismic conditions, Health & Safety groups preference until then was for sites with good foundation conditions so that the existing designs with appropriate modifications could be adopted. The other members, including Chairman of the Committee opined that the health and safety evaluation would proceed more or less simultaneously with the progress of design and felt that safety aspects could be cleared before the deigns could be deemed as available.

From the above, it is evident that Dr. A.K. Ganguly had not rejected the site but instead wanted designs to be developed before sitting a nuclear power project at Narora. This was mainly due to the reason that in 1972 the design of RAPS type reactor suited low seismic areas. In fact, as per the majority opinion of the Committee, a decision was taken to upgrade the design to suit the moderately seismic and alluvial subsoil conditions existing at Narora and the result is the present design evolved.

The truth: The Site Selection Committee of the DAE works under the DAE. Just as the evidence in court of a person in respect of his or her spouse is invalid, so also is the clearance of the Narora site by the Site Selection Committee of the DAE. The fact is that the construction of such a sensitive structure in a densely populated area on the banks of a major river (Ganga), on alluvial soil in seismic zone IV cannot be compensated by the best design calculations.

Q. 9 Is Narora Plant on safe foundation?

DAE: Definitely yes. Narora is located on the banks of river Ganges on alluvial soil. The foundations of Narora reach up to a depth where high relative densities and bearing capacities are met. Expertise on design available from various agencies like Department of Earthquake Engineering, Roorkee, Central Building Research Institute, Indian Institute of Technology, and consultants have been pooled to evolve the design. This design can cater to all requirements envisaged during the life of the plant. To validate design, settlement are being monitored by instruments and the results obtained conform to computed values.

The truth: Safety in any kind of building is always fundamentally an assessment of probability of failure. Also, failure need not mean total failure or collapse. The experts at CBRI, IIT and the University of Roorkee will agree that there is no 100% safe design whether of foundations, of concrete containments, of metallic end-shields, or indeed of anything human-made or natural. Thus, claiming that Narora NPP is on safe foundations is not saying nearly enough of what the public should know. What is left unsaid is that the consequences of a fault or failure in a NPP are so grave and have such long-term effects spanning generations of people, that no assurance of safety is really valid. Further, if nuclear power is a safe bet, how is it that the insurance policies of the Life Insurance Corporation of India (LIC), do not cover accidents or events causing death or disability due to nuclear radiation?

Q. 12 Is Narora Plant seismically safe?

DAE: First, Narora is reasonably away from the Himalayan seismic region. Narora site comes under zone-III. To illustrate this point, it would be interesting to note that even Bombay region is classified under zone-III. Seismicity of this site was evaluated, based on the state-of-the-art existing then and as practised in developed countries. We have the requisite experience and potential to design nuclear power stations to withstand safely all postulated risks in the event of a seismic disturbance.

The Seismic Design Concept for Narora Station takes into account two levels of earthquake; one is known as the operating basis which is expected to occur once during the life of the plant and at which time the reactor is expected to remain operational. The second level gives a ground motion which is considered maximum at which all the safety systems are expected to be fully functional and the reactor shutdown safely. All the requirement and systems which are required to be operational under the above two events are designed to ensure that the Narora Station will be fully safe for the kind of earthquake that is likely to occur during the life of the plant.

The truth: Please see the answer to Q. 9 above. Areas which were a seismic have turned seismically active, e.g., Koyna in Maharashtra during the 1960s. The seismicity of an area changes very slowly over centuries, but the change towards more or less seismicity cannot be predicted for any given area. As far as the levels of earthquake are concerned, the NPP is to continue normal operation upto a certain (design) level of ground accelerations, while at higher levels of ground accelerations, although the safety systems should not fail, the reactor should automatically shut down. This only means that the cooling water pipe connections fo the emergency core cooling system (ECCS) are specially designed against rupture due to earth quake but since risk still exists, the reactor is shut down as a measure of abundant caution. A reactor operating at high power with a suddenly failed cooling system will overheat and melt down, leading to a Chernobyl type of accident. But what if an earthquake of greater intensity occurs than was assumed for purposes of design. For example, the California earthquake of October 17, 1989, could not be predicted either with regard to time of occurrence or with regard to intensity inspite of close watch by scientists and engineers who were well equipped with sophisticated instruments. The damage to structures in this earthquake was staggering. Thus it is clear that here too, the risk is finite. What constitutes a material failure, design failure, operating failure, or system failure to a scientists who tries to look at problems objectively (for that is his training and task), can be a minor incident or a major accident. A nuclear accident in UP would be a major international disaster far exceeding anything known in recent times since Hiroshima.

Q. 14. Whether adequate investigations were carried out prior to design of the structures?

DAE: As in all nuclear projects, a detailed programme for soil investigation was carried out.

The truth: Detailed soil investigations are routinely carried out for all civil engineering projects. The bland statement that "as in all nuclear projects" such tests were carried out for NAPS, conveys that something was done here that is unique to NPPs, particularly NAPS. Indian Standard Specifications and Codes of Practice issued by the Bureau of Indian Standards exist for all kinds of soil investigation for all kinds of foundations in different kinds of soils. No separate National Codes of Practice in respect of NPPs have even been formulated so far. The DAE is thus taking undue credit and misleading the public by stating "As in all nuclear projects, a detailed programme for soil investigation was carried out."

Q. 17. What about public concerns about radiation and radioactive wastes?

DAE: The public at large is also concerned about the effects of low level radiation. What the lay public is not aware is that all of us live in a sea of radiation. We receive cosmic rays from the stars in the universe, radiation from the minerals in the earths crust and from potassium in the sea water. Therefore, radiation is very much a part of the natural environment. However, what is important is that the radiation levels do not increase significantly as a result of nuclear power actives. Around all our nuclear power installations we carry out systematic surveys of background radiation levels. Such surveys are commenced some years before the nuclear installation goes into service. Based on these surveys, we find that the background radiation level at the fence post of a nuclear power station is 1% to 2% higher than that which was

obtained prior to the setting up of the nuclear power station. On the other hand we find that there is substantial variation in the background radiation level from place to place and this can vary by a factor of 3 to 4 and indeed in some instances by a factor of 10. The incremental radiation due to a nuclear power station is therefore far less than the variation observed in the natural background radiation itself.

Another matter of concern of the public relates to nuclear waste management. A nuclear power station, during normal operation, produces very little waste and whatever is produced is stored within the plant premises. High level waste is produced when the spent nuclear fuel is reprocessed and plutonium is separated for use as fuel. The quantities of the high level waste are extremely small and they are generally converted into vitrified glass which is thereafter encased in stainless steel and stored on a long term basis. It will be interesting to note that the entire vitrified waste that the French would be producing upto the year 2000 - they now produce 70% of their electricity from nuclear reactors - would occupy an area of just one football field. This may be contrasted to the enormous amounts of sulphur dioxide, nitrogen oxides, and fly ash that would be discharged into the environment if the same quantity of electricity were to be produced using fossil fuels like coal or oil.

The truth:

This article represents one facet of public concern. The public must know that low-level radiation includes radiation from NPP wastes having a half-life of 30 years or less. These low-level wastes (LLW) include contaminated clothing of NPP personnel, machinery, filters etc. and gaseous and liquid effluents from the process which are dangerous and remain so for about 100 years (for those components with half-life of about 30 years). The radionuclides involved are Tritium (radioactive Hydrogen), Cobalt (Co_{60}), Krypton (Kr_{85}), Ruthenium (R_{106}) and Argon (A_{41}). A 1000 MWe reactor produces about 2000 cubic metres of LLW every year. This is certainly small in volume compared with the 100,000 cubic metres of ash and smoke from a coal-powered station, but the fact of its dangerous radioactivity is overlooked by the DAE. LLW is normally stored within the boundaries of the NPP in concrete-lined trenches. The life of concrete (however well made) for such hazardous wastes is about 15-20 years after which it can crack and require heavy repairs. But these concrete trenches cannot be repaired since they hold highly toxic wastes; their contents can therefore seep into the ground slowly, contaminating the ground water and wells and exposing people to low-level radiation. The spent fuel of a reactor is very dangerous and is called high-level waste (HLW). It is to be stored under water for several years since it generates heat. No doubt it is small in quantity but its nature makes it extremely dangerous for many thousands of years. And to date, no really satisfactory method for its disposal has been devised. Vitrification of HLW is currently being done in Europe but this is prohibitively expensive ours DAE is proposing to dump it in the deep mine shafts of the Kolar Gold Fields in Karnataka - and guarantees of safety over time spans of tens of thousands of years mortals with a working life span of 30 years is simply laughable. If we do not know what to do with waste, we have no business to be generating it and risking the safety of future generations. The statements by the DAE that the background radiation is part of the environment and that we live in a sea of radiation are correct but significantly incomplete. No doubt the Uranium mined from the earth was already there giving off radiation, but there are two significant points here: first, the Uranium was dispersed and was deep under the ground and the radiation on the surface of the earth was low; second, the operation of a nuclear reactor makes Plutonium (P_{239}) out of Uranium (U_{238}) which is not radioactive (only Uranium U_{235}) is radioactive), and the nett radioactivity thus increases, increasing the general levels of harmful radiations. Thus, background radiation increases due to the release of Radon gas into the atmosphere due to Uranium mining, and due to the production of P_{239} and Uranium (U_{233}) in reactors. While mined Uranium (consisting of U_{233} and fissile U_{235}) is only mildly radioactive, the decay products of U_{235} (which include Thorium (Th_{230}), Radium (Ra_{228}) and Radon (Rn_{222}) are more dangerous. These radioactive elements would have existed whether or not the mining had taken place; they now become more readily dispersed throughout the ecosystem, thus increasing the hazard of low-level radiation. Take for example, the tragedy of Jadugoda, 45 km from Jamshedpur in Bihar, where the Uranium Corporation of India Ltd. (UCIL) mines uranium. This uranium is processed and sent to the Nuclear Fuel Complex in Hyderabad where it is made into fuel rods for use by atomic power plants. A kilometre away from the UCIL factory is the tailing pond, where radioactive wastes are dumped. This pond is the only source of water for the neighbouring village of Dungridi, and the radioactive dust from the dry scum on the surface

of the pond, fills the air. Cases of congenital deformity, leukaemia, prenatal death & bone diseases are on the rise. In another decade, the village could cease to exist.

Q. 18 What precautions are taken about Health and Safety aspect

DAE: Health and safety aspects of atomic energy development have received intense attention right from early stages of the programme. We have very large groups of scientists involved in the study of interaction of radiation with living matter. At all our nuclear installations we deploy professional health physicists who monitor the exposure of all individuals working at the plant including those who may work there on a casual basis. These health and safety personnel also monitor all the effluents that are discharged from the power station premises to ensure that they comply with national and international standards. In addition, the health and safety specialists also operate environmental surveillance programmes extending upto 30 kms from the location of the power station. The nuclear industry is unique in adopting a cradle-to-grave approach in so far as it concerns the safety aspects.

Elaborate steps have been taken and will continue to be taken to ensure a very high degree of safety. The safety procedure are under constant review to ensure that at all times radiation exposure is well within limits not only to the plant personnel but also to the public at large. The Atomic Energy Regulatory Board (AERB) is responsible for carrying out regulatory and radiation safety functions in all installations of the DAE, and in radiation installations operated by medical, industrial and research users in the country. Towards this end, it has developed safety codes, guides and standards. Apart from continuously reviewing all operational aspects of radiation installations including emergency preparedness plant, it also keeps the public informed on major issues of radiological safety.

The truth: The health aspects of nuclear energy are worrisome and were responsible for the formation of an international body, the International Commission for Radiological Protection (ICRP), in 1928. The 'safe' annual dose was reduced to 50 rads (from the existing 75 rads) in 1936, to 25 rads in 1948, to 15 rads in 1954, to 5 REMs in 1958 and 0.5 REMs in 1981, all by the ICRP. What the ICRP considered a 'safe' dose of annual radiation in 1981 is 150th part of the safe dose reckoned in 1928! Accordingly, the international safety standards - set by the International Atomic Energy Agency (IAEA) for operation of NPPs have been made increasingly strict. The fact of the matter is that nuclear energy is based upon one gigantic hoax viz., that there is a safe level of radiation. There is none. The IACA itself uses "the phrase maximum permissible dose" and not 'safe dose'.

Q. 20 Is River Ganga likely to us polluted by radioactive discharges from Narora Plant?

DAE: The liquid waste management system at Narora is designed on the basis that no radioactive effluents, treated or otherwise, will be discharged into the river Ganga.

Being an inland site, the requirements of a fresh water environment especially those of a river site have been kept in view in the liquid waste management scheme. On this basis, the plant has been designed to generate minimum quantities of radioactive waste, maximum processing of and minimum discharges to the environment. These discharges will further be diluted by the purge from the cooling towers and released into the canal. Based on RAPS experience, actual quantities discharged will only be a fraction of the limits, which are derived from internationally accepted criteria. In the derivation of these limits, the living habits of Indian population have been considered.

The truth: The answer to this a simple "yes". Every nuclear power reactor in the world is constructed near a large body of water or near a large river. This is because of the heavy thermal wastage (70% of the heat generated) which must be dumped. Some of the radioactivity therefore essentially finds its way into the water body. The nuclear engineer's task of operating the NPP is a tight-rope walk, balancing safety requirements, reduced operating hours and higher operating cost on the one hand, with overlooking "minor" leaks or accidents, increasing the operating hours and cutting corners to lower operating costs on the other. A difficult task, indeed. Between operating safety and environmental pollution by radioactive effluents lie the very human weaknesses and failings of the nuclear engineer. The DAE's statements that "the plant has been designed to generate the minimum (!!) quantities of radioactive waste" and "actual quantities discharged will be only a fraction of the limits which are derived (!!) from internationally accepted criteria", is a play of words designed by their Department of Public Awareness to fob off the casual reader.

Q. 21 Can a nuclear reactor explode like an atomic bomb?

DAE: Not at all: The design of a nuclear reactor does not permit such explosion.

The truth: A nuclear reactor of the fast breeder type (FBR) can explode like a nuclear bomb because increased fuel compaction due to say, a partial melt down, causes increased reactivity and the fissile mass becomes critical. However, the Narora reactor is not a FBR but a pressurized heavy water reactor (PHWR), and cannot explode like a nuclear bomb; in this type of reactor, increased fuel compaction actually reduces the reactivity because the type of fuel is different from an FBR. Nevertheless, as in the Chernobyl accident, a steam or hydrogen explosion can occur and breaching of the containment is perfectly possible. When the containment is breached, the radioactive steam and fuel particles are vented into the atmosphere without control. If however the containment holds, then radioactivity is discharged into the environment in a more or less controlled manner with or without information to the public. So, a strong containment is very important to nuclear engineers; but the public receives every scrap of radiation that may accrue from any and every incident.

Q. 22 Are there any hazards to future generation?

DAE: There is no unambiguous evidence that irradiation causes genetic effects in man particularly at the low-dose level he is exposed in the vicinity of nuclear power plants.

The truth: There is clear (though may be weak) statistical correlation between exposure to radioactivity and genetic effects in human beings (and many other life forms besides). This is borne out by the DAE's statement that "there is no unambiguous evidence....". The onus of demonstrating unambiguous does not lie with the citizen, whatever the dose level. It is quite ridiculous to have to wait until the dangers of nuclear reactors are proven conclusively so that the DAE staff (who may in the meantime have retired!) can admit, "Yes, you are right", and the anti-nuclear activist (or her deformed child) can say, "But I told you so in the first place!" Future generations will pay the price for the lack of involvement, ingnorance, greed and selfishness of the present generation.

Q.24 Has the Department of Atomic Energy prepared detailed plans to handle emergency situations arising out of events that can affect either station personnel and/or the public? Are the public authorities involved in these exercises/drills?

DAE: Department of Atomic Energy had drawn up emergency plans for on-site and off-site emergency situations. These were reviewed by the safety review bodies in DAE before these units were made operational. Detailed action plans for public authorities have also been prepared for all of-site emergency situations. Drills have been conducted to assess the efficacy of the plans/procedures and to eliminate detected inadequacies. These have been found to be extremely useful. In fact a co-ordinating cell has been instituted in DAE to ensure improved coordination in the event of any emergency. The involvement of various public authorities in the review of these plans, procedures and drills has been found very useful. DAE has been conducting seminars in several cities (Bangalore, Mangalore, Lucknow etc.) to increase public awareness in radiation related matters with particular reference to nuclear power and fuel cycles. This is a continuing activity.

The truth: The emergency planning by the DAE for population evacuations which is for an accident situation at NAPs should be seen in the context of its location in the thickly populated Bulandshahr District of UP. After the Chernobyl accident in April 1986, an area of thousands of hectares around the reactor was vacated. Now, more than three years after, the area is not yet occupied as it is too radioactive and unsafe. In the case of NAPs, the resettlement of the survivors of several million people will be the main problem - their emergency evacuation, however carefully it is planned and rehearsed, can never the executed. The "Seminars" conducted by the DAE for public awareness are only propaganda meetings during which no awkward questions or dissent is permitted. To date, the DAE has not accepted a single open public debate in the main issues of nuclear power viz., safety against accident, radiation hazards during normal operation, disposal of radioactive wastes, and cost. This consistent one sidedness of the DAE does little to assuage the genuine fears of the thinking public. The public authorities involved in this emergency planning must also ask themselves if the whole exercise is not a bit of the usual official eye-wash.

Knowledge of the plant and of nuclear hazards

The knowledge the villagers have about the plant is partial and in many cases, distorted. Evidently, those who bear the brunt of dislocation are not considered important enough to be briefed about the kind of work the plant does. Worse still, they have not been given any information at all about what they are to do in case of an accident.

Some who work in the plant have a clearer idea about nuclear energy. These are also the ones who mention accidents, and incidents of workers being exposed to radiation. We cannot verify these stories since the DAE does not give the public access to such information. However, we have retained reports of such incidents simply to point to the workers' knowledge about the issues involved.

Name : Om Prakash, Village: Ramghat

"They told us that electricity generated in the plant releases a poisonous gas. The gas will harm us, our grains will get spoiled, water will get affected, we will die...."

Name : Yadiram, Village: Ramghat

"Buffaloes grazing near the plant had died..."

Name : Rambharose, Village : Ramghat

"DM Sahib told us that gas will be released from the plant so we should leave our houses. What type of gas it is we don't know..."

Name : Kalawati, Village: Ramghat

"We were told that our grains will get poisoned, grass will dry up due to the poison, animals, plants all will die... But our cattle still graze near the plant. What to do? There is no other place where they can get anything to eat..."

Name : Kumkum, Age: 10 yrs.
Colony: Bijaun Nayi Basti

"Our village has been abandoned, that is why we are here. A power house was being made there. When it started working, we would have died. My father told me this."

Name : Unknown (Woman)
Colony : Bijaun Nayi Basti

"... They told us that a power house was being built. The electricity will be made from the rays of the sun god. What these rays are, we don't know... We were told that if we get exposed to radiation our limbs will be deformed, or our babies will be born deformed. That is why we were settled 3 miles away from the plant..."

Name : Rameshwar
Colony : Bijaun Nayi Basti

"We were not allowed to sow anything in Hakimpur.... they said that there is danger from radiation, don't sow anything..."

Name : Ramwati
Colony : Bijaun Nayi Basti

"We have not been told what we are to do in case of an accident in the plant. They said that if something happens we will be taken out of the area in buses."

Name : Jaisingh
Colony : Bijaun Nayi Basti

".... To make us leave the village they told us that there can be an explosion like Bhopal."

Name : Bankelal
Colony : Bijaun Nayi Basti

"Some men in the plant have got radiated. Pukhraj's whole body is useless. He becomes like a statue and starts shivering."

Name : Unknown
Colony : Ambedkar Basti

"In this plant, electricity will be generated through the eclipse of the sun and the gas which will be produced inside can harm us if it is released."

Name : Unknown (worker at the plant)
Colony: Ambedkar Nagar

"The boiler line taking heavy water to the turbine burst recently. We welded it... The plant was shut down for a month. When the Prime Minister came to inaugurate the plant it was not working.....

Many workers have died because of radiation. When the contractors get letters from their homes, they reply that these men have left the plant and their accounts have been cleared."

Name : Gulab Singh
Colony : Ambedkar Nagar

"I work in the plant, I do inspection work. When the plant starts, radiation can spread in the nearby areas and the villagers will suffer... because of radiation there can be a loss of blood in the body, pain in arms and legs and if a person gets a large dose of radiation he can die too... There are many labourers in the plant who do not know anything about radiation.... one man got radiated and as soon as he stood up, he started shivering."

Name : Ranvir Singh
Colony : Ambedkar Nagar

"I have been working in the plant since the past 5 years... About a month before Rajiv Gandhi came here, there was a heavy water leakage. The heavy water was in a tank, which was opened by mistake. When we learnt about the leakage everyone ran away from there... There was no one in the control room.... Finally to clear it up, labourers from outside were called in, on daily wages, they were paid around 20 to 25 rupees."

Name : Unknown (worker at plant)
Colony : Ambedkar Nagar

"When someone is exposed to radiation, then if he is normal he is put into hospital, if he is seriously affected he is put behind a glass sheet. If his family comes to see him, they look at him through the glass and come away."

Name : Unknown, Colony: Sundarnagar

"We were told that the plant makes papads, & smoke comes out of these. This smoke can damage your eyes."

Name: Mir Kasim (worker at the plant)
Colony: Sundarnagar

"The day after Rajiv Gandhi came to start the plant, there was a fire in part of the plant. I was working inside, welding something... I came away. A friend who was there is in hospital now."

"Most employees of NAPP are apprehensive about the plant going critical in 1988, nobody wants to take the responsibility of irradiating the Ganga"

M.P. Gaur, Secretary, Parmanu Urja Shramik Sangh, (NAPS)
Hindustan Times Sunday Magazine, Dec. 27 1987.

At present nuclear power contributes only 2.5 per cent to the country's electricity production. Of total energy consumed, nuclear energy's share is a mere 0.5 per cent. This, at the cost of genetic deformity, cancer, sterility and environmental destruction.

Effect on the Community

The breakdown in human relationships is unquantifiable but harshest in its immediate impact. The interview with the young boy Moolchand brings out clearly the loss of a sense of mooring and direction. Most heart breaking is the mention of children who used to go to school but now must labour to make ends meet.

Name : Unknown (Woman)
Colony: Bijaun Nayi Basti

"Entire families have been separated. Our five villages have been uprooted. Some started living with their relatives and some settled wherever they found it convenient, but most of the people are living in Narora....

Young people have changed in the sense that they are all sitting idle and jobless. Earlier they had their work, they made ropes, worked in the field or with the cattle."

Name : Udal Singh
Colony : Bijaun Nayi Basti

"In Badipur there was a school. Now there is nothing. Children have to go to very far or don't go to school at all. Some children are working as labourers..."

15- year - old Mool Chand

Q. So you have left your village and come here. How do you like it?
MC I don't like it here.
Q. Why?
MC It was fun there, here it is different. There we were happy, here we are not.
Q. Have you go separated from your friends?
MC Yes, some are living in Kalkatti, some are living with their relatives and some have settled here.
Q. Is that why you don't like it here?
MC Yes.
Q. You used to go to school there?
MC Yes.
Q. And here?
MC No.
Q. Why?
MC It is very far from here. How can I go?
Q. But there is a school here too?
MC Here some children do go. Some don't because of work.
Q. Do you work?
MC Yes, I make ropes. There is no land now, no plough, but we have to feed ourselves.
Q. What did you use to do there?
MC I used to plough my land earlier. I used to grow wheat there. Now we don't have our land, so what can we do? If we get land and our plough then only we can grow wheat and fill our stomachs.
Q. Do you know why you have been shifted here?
MC No, I don't know. No one has told me...

"Those who have suffered losses, they are not the ones who are likely to get electricity"

(a man from Ambedkar Nagar)

" Nuclear power is the safest form of energy yet known to man"

Peter Walker, British Minister for Energy, 5 weeks before Chernobyl.

Interview with Ayurvedic Government Doctor in Ramghat

This interview with Dharamvir Singh Verma, Doctor in the Government Ayurvedic Clinic - presumably among the most literate and informed people in the region - speaks for itself.

Q. You live in this village?

DSV No. I am from Jalaligarh, about 28 kms from here.

Q. Why have the people been shifted from the place where the power house has been built? What do you know about it?

DSV I only know what is being said here - that the gas of this plant is radioactive. They say that if this gas spreads it will harm the people.

Q. Did you try to find out something about how far this radiation can spread?

DSV There are two sections of people here, one is against the plant, the other wants to keep it. The group opposed to it has said that the gas can spread till Muzaffarpur, Pilibhit, Etawa and Bharatpur.

Q. Do you know what will be the effect of the gas?

DSV The gas will affect the genes for anything from one year to thirty years. As with syphillis this disease is passed on from generation to generation.

Q. Have you told people about this?

DSV Why should I tell anyone anything? What has it got to do with me? Our department is of the Uttar Pradesh Government, that is the Ayurvedic department.

Q. But if people get a disease?

DSV It is true there are diseases, they recommend Iodine tablets etc. they ask the villagers to take Iodine tablets but they never provide them. They are expected to take these tablets on their own.

Q. Iodine tablets for the gas in the power house?

DSV Yes, for the gas. This gas harms the genes, stomach and the throat.

Q. Is there any one who has been harmed by the Gas?

DSV No one has so far been affected by this gas. The villagers here are not scientific people that they would know about all this. Wherever you push them, they will go.

Be warned: great efforts will be made to sustain the industry. Why? Because there is huge vested interest: capital, specialist jobs and a vast quantity of face to be saved. There are many in the government, civil service and electricity supply industry who simply made the wrong decision, and in attempted exoneration, have presented some very strange figures.... There are the suppliers of material and equipment for the industry, not all of whose products were quite as good as they promised....

ECOROPA Information Sheet 15

The DAE claims it hold seminars and awareness campaigns among the people of Narora. In 1989 it organised such an exercise, which some of us attended. It was little more than a demonstration of civil defence and ordinary fire fighting. This is what a villager has to say of it.

Name : Manak Chand

Q. Has any one told you how to protect yourself in case of an accident in the plant?
M. No, we have been told nothing.
Q. We heard that there was a drill here?
M. That was just a big drama. They came in a car and left after the rehearsal. No one gained any information.
Q. What did they tell you at that time?
M. If a man dies on the roof of his house, how to bring his body down - by putting a ladder against the wall or by using a rope. What to do and where to run in case of fire.
Q. Nothing was said about radiation?
M. No.

Name : Bankelal, Colony: Bijaun Nayi Basti

"No MP or anyone came to help us. When 3-4 villages got together and went on a hunger strike, near Nandpur village, we repeatedly said that the Prime Minister or someone should at least listen to our problems. But no political leader or MP came to talk to us. One MLA promised to get our demands fulfilled in the Vidhan Sabha. We believed him and finished our hunger strike. DM Sahib said that he will get us full compensation, give us land and other facilities and we believed him. But...."

We're only too conscious of our limitations in this entire exercise. So the following remark by a 13-year old girl, made to villagers speaking to us, was humbling. Self critically, we recognize the cynicism and frustration felt by the people of Narora.

"It's useless speaking to these people. They'll just take photographs and go away".

Conclusion

Our emphasis may appear to have been on the issue of compensation to the affected people. After all, what is most easily visible is the human angle, the suffering, displacement and loss of property. Invariably, all large development projects have been planned and implemented without consulting the people affected - like the Pong, Rihand and Hirakud Dams, and most super-thermal projects. In all these cases there have been promises of compensation which may or may not have been paid, and of land and occupations which may or may not materialize. These human costs are not included in the reckoning.

However, while compensation and relocation are vital, immediate issues, we would point to more fundamental questions - in what direction is such development taking us? Would it be sufficient if the dislocated people were given fair compensation? Is a 'fair' compensation possible for fishing rights or cultivable land or employment as agricultural labour? Who are the people to benefit from large scale capital intensive development?

The fruits of our development strategy are reaped by ten percent of the population while the price - in terms of labour, the dislocation, the distress - is paid by the remaining ninety percent. In the specific context of nuclear energy, even more complex issues are raised - apart from being part of a destructive, non-equitable development strategy, the nuclear energy programme sets into motion an irreversible process, endangering the lives of generations. We're in a no-win situation here - if the programme continues to be unsuccessful in generating sufficient energy, there is the colossal waste of resources. If it is successful we face nuclear and thermal pollution.

And finally, can any nuclear energy programme be entirely peaceful? India has a weapons capability - might we not be tempted to join the nuclear arms race? The escalation of tension on the sub-continent will then be inevitable. Do we fully comprehend the implications of such a situation?

We must seriously question a 'development' which violates every tenet of social justice, ecological morality and political sanity.

CHERNOBYL.
The experts said "It can't happen"
It did.
Our turn next?

THE COMPTROLLER AND AUDITOR GENERAL OF INDIA'S REPORT ON THE NARORA ATOMIC POWER PROJECT

Narora Atomic Power Project consisting of two units of 235 MWe each was sanctioned in 1974 at a cost of Rs.209.89 crores with date of criticality as December 1981 and December 1982. Till December 1988, neither of the units had reached criticality. Rs. 487.36 crores have already been spent by March 1988 and a proposal to revise the project cost to Rs.532.84 crores is pending. The time and cost over-runs were attributed to continuous upgrading in systems design to cater to seismic conditions and safety, consequential delay in construction activities stretched upto 43 months and cost over runs upto Rs. 400 lakhs in individual cases. There was no dynamic monitoring resulting in tail-end facilities coming up earlier; also equipments like chiller units, cranes, etc. were acquired ahead of requirements. A random check of purchase orders revealed substantial delay in placement of purchase orders. Performance budgets failed to take cognisance of previous performances and annual reports were inaccurate. In sum, though the seismic conditions of the site were known at project formulation stage, which called for special designs for equipments and buildings optimistic time schedules were drawn up and projected project cost estimations proved inadequate.

Introduction

Narora Atomic Power Project (NAPP) is located on the right bank of the river Ganga in Bulandshahr District of Uttar Pradesh and is the fourth nuclear power station of the Pressurised Heavy Water Reactor (PHWR) type in the country and consists of two units of 235 MWe each. The project was sanctioned in 1974 with scheduled date of criticality as December 1981 and December 1982 respectively for the two units. The original sanctioned project cost was Rs. 209.89 crores for two 235 MWe power stations. The project cost has been revised to Rs. 399.64 crores in 1982. DAE had made a proposal, in 1985, to further revise the project cost to Rs. 532.84 crores which is pending approval. Neither of the units has been commissioned till December 1988 and the expenditure upto March was Rs. 487.36 crores.

Scope of Audit

This review covers the progress at NAPP during the period January 1974 to March 1988 and the major reasons for the delay in commissioning as well as the cost escalations.....

Organisational set up

The execution of the power projects was the responsibility of the Power Projects Engineering Division (PPED) in the Nuclear Power Board (NPB) of the Department of Atomic Energy (DAE). This has since been taken over by Nuclear Power Corporation of India Limited with its formation in September 1987. The construction and commissioning of the project is supervised by a Project Director at Narora.

Highlights

Narora Atomic Power Project (2x235 MWe Units) was sanctioned in 1974 with the scheduled date of criticality as December 1981 and December 1982 respectively. This had not been achieved till December 1988.

- The original sanctioned project cost of Rs. 209.82 crores was subsequently revised to Rs. 399.64 crores in 1982. Only 87 per cent of the project had been completed and Rs. 487.36 crores had been spent upto March 1988. A proposal to increase the project cost to Rs. 532.84 crores had been made in 1985 and is pending approval of Government.

- There have been series of design changes affecting the progress of work and design changes have continued for 13 years after the commencement of the Project....Quality surveillance of CS Pipes meant for liquid waste transportation was not done both at the time of supply and resupply. Finally these were dismantled at a cost and were replaced by stainless steel pipes.

- Out of four cranes bought in April/May 1980, only two were erected in time. The idle investment of Rs. 14.45 lakhs on the other two cranes continued for about two years.

- One chiller unit costing Rs. 21.64 lakhs bought in August/October 1984 remained to be commissioned.

-- An imported equipment costing Rs. 17.13 lakhs was lying idle for two years.

-- Mechanical and electrical stores and equipments valued at Rs. 20.06 lakhs were lying idle for periods ranging from 5 to 11 years...

Delays in Commissioning

The time over-run on the project is about 86 per cent. Unit-I which was to have reached criticality in December 1981 had not reached criticality till December 1988. Unit-II expected to reach criticality in December 1982 is now expected to reach criticality in May 1990.

Delays due to design changes

The Project Report stated that NAPP was to be designed on the lines of Rajasthan Atomic Power Project (RAPP) and Madras Atomic Power Station (MAPS) since the production programme for the manufacture of allied reactor components and materials had progressed significantly and it was desirable to utilise the experience gained in building the Madras Atomic Power Station (MAPS) and Rajasthan Atomic Power Station (RAPS). It was also stated that the technical plant details were more or less identical with those of RAPS and MAPS with few modifications to suit the seismic conditions obtaining at Narora.

The following extracts from the Annual Reports of DAE also stated that the designs had been finalized:

-- 1973-74: The reactors proposed for Narora though based on the basic CANDU system adopted at Rajasthan and Kalpakkam include several design improvements. The design also has to take into account the seismic conditions at site. The design and development work in this regard is progressing in PPED. Conceptual designs and details of developments and prototype testing work to precede freezing of design have been finalised.

-- 1974-75: In view of the modifications made in the RAPP and MAPP designs for the Narora Reactor Vault equipment, development and proto-type testing work for finalising these design changes have been started.

-- 1977-78: Detailed engineering for the major systems like secondary cycle system, compressed air system, domestic water system, chilled water system, demineralised water system, fire and standby water system and ventilation system etc. in progress.

Standardisation of design was to enable repetitive ordering and streamlining of the production programme of the equipments and components, leading to reduction in delays and cost escalations. However, designs had not been standardised and frozen...

DAE stated in December 1988 that a number of design improvements were necessitated by seismicity and safety considerations and only the basic concepts of designing PHWR were available from RAPS and MAPS. In addition, the non-availability of cooling water from Ganga necessitated certain changes. It was also stated that safety considerations which were evolutionary had led to engineering of additional systems. As an example, re-engineering of ECCS on the basis of Three Mile Island accident has been cited. That accident had occurred in 1979 whereas the drawings of the cooling system were revised in February 1987. Further, if designs as evolved for RAPS and MAPS could not be followed for NAPP, it was not correct to say in the project report that the production programme of reactor components etc. had advanced on the basis of these designs and they would be adopted. It was also incorrect to state in the Annual Reports of DAE that conceptual designs and proto-type testing work, after taking into account the seismicity of NAPP had been finalised. It was even stated in 1974-75 and in 1977-78 that detailed engineering of various major systems had been started while normally detailed engineering follows design freezing. Thus, without stabilising designs and cooling water arrangements approval to the project was obtained.

While considerations for maximum safety cannot be disputed, since these were evolutionary a trade off between safety and schedule adherence was called for especially in the context of other nuclear plants in the country continuing to operate with earlier standards of safety. The extraordinary delay in stabilising various designs is borne out by DAE's reply in December 1988 that design drawings of Reactor Monitoring System and Reactor Regulating System have since been received. Further, DAE had dealt with only one system in its reply while 10 such delays were cited.

Delays in construction

There are three major structure/plant areas in the nuclear power plant, namely, reactor building, turbine building and service building. The construction and installation activities in the reactor building are in general on the critical path. Delays in finalising the designs also led to delays in the procurement of equipments and consequently delay in the construction of system oriented buildings. Thus the reactor turbine service building, heavy water upgradation building, waste

management plant building and natural draught cooling towers were delayed by 43, 22, 27 and 17 months respectively. DAE admitted in December 1988 that design changes increased the size and number of components which in turn led to redesigning of the buildings...

Cost over run

As against the revised (1982) project cost of Rs.399.64 crores, the expenditure upto March 1988 was Rs.487.36 crores. Another 13 per cent work remains to be done and there is a proposal (1985) to revise the total project cost to Rs.532.84 crores....

DAE stated in December 1988 that since detailed designs of NAPPwere not available, costs on the basis of MAPP was extrapolated. However, due to various design changes on account of seismicity, safety etc. the scope of work increased and along with it the cost. Thus, after stabilising the designs the cost was revised to Rs.399.64 crores in 1982. According to DAE, even this cost was not firm because the price of steam generators had not been finalised by then. Additional expenditure was also incurred on account of safety considerations.

The project had already proposed in 1985, revision of cost to Rs.532.84 crores on the premises that the project would reach criticality in 1988. This has not happened and the cost is likely to go up. The extent of revision 95 per cent in 1982 and 64 per cent in 1985 indicates that project was got approved on unrealistic cost estimates. Unrealistic cost estimates and optimistic time schedules make financial allocations and controls less meaningful.

Monitoring

The Performance Budget 1987-88 stated that there were slippages in the construction due to problems faced in the acquisition of land, delay in finalisation of designs, delay in fabrication of major equipments, technical problems encountered during construction and non-availability of construction materials. It was also seen that the annual performance was much below the anticipated levels and there was no significant improvement...targetted level of completion for 1983-84 was reached in 1986-87 and only 87 per cent of the project had been reported as completed in 1987-88.

There was no dynamic monitoring of the project to keep down delays and costs. Facilities like heavy water upgradation building, waste management plant building and natural draught cooling towers had come into being at a cost of Rs.6.42 crores much before the main plant. These are tail-end facilities which could be put to use only after the start-up of the plant. As such these facilities are idle investments and the interest during construction only on these would work out to Rs.313 lakhs for 7 years.

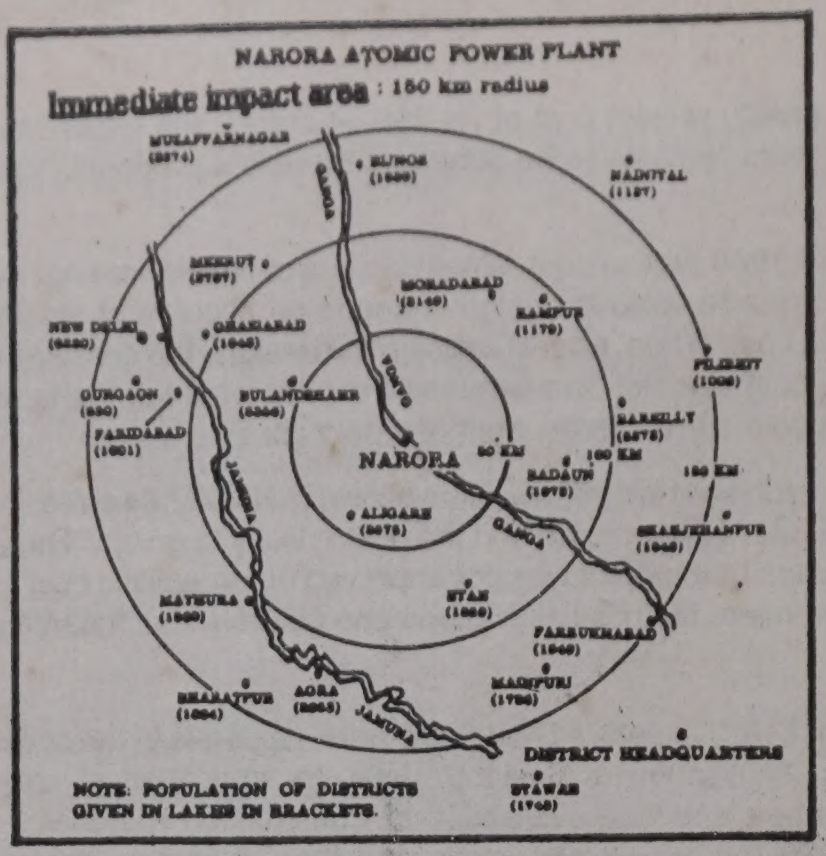
Similarly, when the construction time required for the heavy water upgradation plant building was only 17 months and the work could have been awarded after the last steam generator was delivered, it was actually awarded in August 1982 i.e. at a time when even the first generator had not been delivered. Such early award of work without any dynamic recasting of schedule, based on other achievements in the critical path, resulted in the manufacturer/contractor waiting to commence the work and finding these jobs unprofitable when they actually took up the jobs at a later date. Consequently, with loss of motivation the jobs got delayed with attendant cost overruns. It was also difficult for DAE to plan for supply of free materials when such jobs were actually taken up at a later date resulting in avoidable payment of escalation costs.

Poor Quality Surveillance before acceptance

In January 1985, NAPP placed an order for 1800 metres of Carbon Steel (CS) pipes on firm 'A' to be utilised in transporting liquid waste. Firm 'B' was awarded the work for laying the pipes. Firm 'B' noticed that the CS pipes were deeply pitted and were of poorquality. Thereupon, firm 'A' agreed to do the mechanical cleaning of the pipes at their own cost. Accordingly, 713.36 metres of cleaned pipes and 1101.05 metres of new pipes supplied by firm 'A' were accepted. However, these two lots were mixed and during the process of erection, it was noticed that the wall thickness of some of the pipes were less than the required specification. Consequently the entire lot of pipes were rejected and pipes erected at a cost of Rs.1.44 lakhs were dismantled. Subsequently, Stainless Steel pipes were substituted for CS pipes.

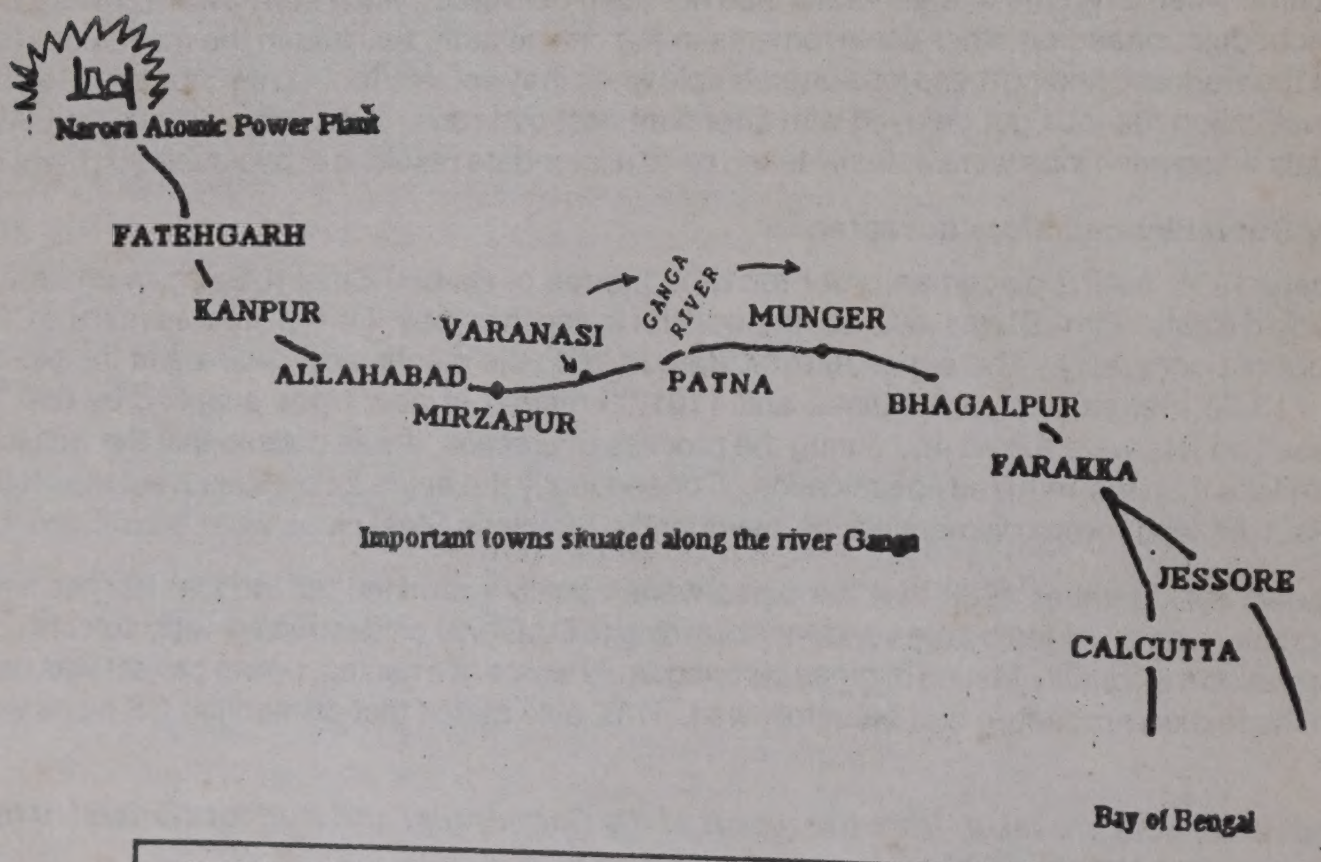
DAE stated in December 1988 that the pipes were visually examined for random lengths since manufacturer's certificate of quality was provided by the vendor. According to DAE only on destructive test, defects could be noticed. To an Audit observation that quality testing of pipes carrying liquid waste of a nuclear power project was not done, DAE stated that standard inspection procedure had been followed. DAE also stated that dismantled CS pipes were utilised in other facilities.....

The above extracts are taken from the report of the Comptroller and Auditor General of India (No.7 of 1989) for the year ended 31 March, 1989.



The time bomb has started ticking

How far are you from it?



STOP NUCLEAR POWER BEFORE IT STOPS YOU

NARORA ATOMIC POWER PLANT - IMMEDIATE HINTERLAND

Location of (i) Displaced villages from the 1.6 km safety zone (ii) New resettlement sites (iii) 1.6 km safety zone (iv) 5 km 'control area'

Key

Distances are in Kilometres (2 cms denote 1 km.)

Inner circle denotes the 1.6 km boundary from which the villagers have been evicted

Outer circle denotes the 5 km control area of the DAE. All activities in this area will be regulated by the DAE.

Names of settlements in bold letters indicate villages that have been razed & hence exist no more.

People are now in settlements which lie outside the 1.6 km boundary

Map adapted from Sheet 53 L/8, 1:50,000 - First Edition Survey of India

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